Identification	**Subject**	PETE 338 Fluid Mechanics for Petroleum Engineers 6 ECTS	
	Department	Petroleum Engineering	
	Program	Graduate	
	Term	Fall, 2023	
	Instructor	Rashad Nazaraliyev	
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	Phone:		
	Classroom/hours		
	Office hours		
Prerequisites	Engineering Mechanics, Introduction to fluid mechanics, Differential Equations		
Language	English		
Compulsory/Elective	Compulsory		
Required textbooks and course materials	• Heriot Watt manual. (2015) Advanced Fluid Mechanics and Modelling. • Douglas, J.F. (2007) Fluid mechanics. Harlow: Pearson. • White, F.M. and Chul, R.Y. (2017) Fluid mechanics. Chennai, India: McGraw Hill Education Private Limited.		
Course outline	The aim of this course is to cover more advanced topics in fluid mechanics and introduce aspects of computer-based modelling that are used to solve fluid mechanic related problems. Delivery mode is via both lecture sessions supported by tutorial problem solving sessions. Computer modelling is largely workshop based with learners completing several topics covering a range of numeric techniques to solve problems that are largely based on fluid mechanics. Project is advised to be implemented using MATLAB, VBA, Python.		
Course objectives	Appreciate the range of technical issues and terminology associated with the behavior of fluids found in the oil and gas industry. • Gain experience of writing computer programs. • Demonstrate professional attributes associated with professional engineers – adhering to deadlines. • Appreciate the range and limitations mathematical numerical modeling as applied to physical processes.		
Learning outcomes	On completion of the course, the student should be able to: • Derive expressions that describe a particular aspect of fluid behavior. Examples include velocity profiles of non-Newtonian fluids in pipelines, flowrate of compressible fluids, flow through porous materials. • Apply and use several conventional theoretical expressions found in fluids: examples include pressure losses across packed beds, critical pressure ratio for choked flow, two phase pressure drop. • Develop numerical schemes to solve partial differential equations in 2D steady and transient examples.		
Teaching methods	**Lecture**		x
	Group discussion		x
	Practical exercises		x
	Case analysis		x
Evaluation	**Methods**	**Date/deadlines**	**Percentage (%)**
	Midterm Exam		30
	Final Exam		40
	Projects		30
	Total		100
	• 3 or 4 projects will be distributed throughout the classes. A project represents an individual/collective endeavor undertaken by students within the realm of scientific inquiry. The incorporation of projects into the curriculum serves the dual purpose of showcasing the subject's research endeavors to potential students		

	and illuminating the ongoing scholarly activities within the field. • Midterm will be carried out in the week announced by the university. Time allocated will be announced close to the midterm. A midterm examination is a test administered approximately midway through an academic grading term, be it a quarter or semester. Its primary objective is to provide students with a clearer assessment of their progress within the course, enabling them to gauge their performance and understanding up to that point. • Final exam date and time will be defined by the University. A final examination is an evaluative assessment presented to students at the conclusion of an academic term or course of study. This assessment typically consists of a predefined set of questions or exercises designed to gauge students' proficiency and comprehension of the subject matter.
Policy	• **Preparation for class** The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes, assigned chapters and get ready for class assignments. Throughout the semester students will also have practical exercises and quizzes. • **Withdrawal (pass/fail)** This course strictly follows grading policy of Graduate School of Science, Art and Technology. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year. • **Cheating/plagiarism** Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0) without any considerations. • **Professional behavior guidelines** The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited. • **Expected behavior** Includes attending all class activities; meeting deadlines; observing common courtesies to fellow students, teachers, and staff; being honest; making a diligent effort to learn; and does not engage in any disruptive irresponsible manner. Legitimate collaboration is encouraged but academic collusion or dishonesty will not be tolerated. ▪ **Class attendance** Attendance is required! Please be in class on time. Attendance will be taken at the beginning of each class period. In case you are not present when attendance sheet is passed on, you will be marked absent. If students who are late for lessons for more than 10 minutes to class will be marked absent, despite this, the student can still attend the class. You shall receive 5 bonus points at the end of the semester if you attend all classes and follow all course policies and procedures.

	• **Class discussion** Feel free to voice your opinions and ask questions anytime during a class period. Practice your right and freedom to learn. Remember you are here to learn and we are here to teach and that teaching and learning are forever intertwined. You can help me teach you as much as I can help you learn. Be an active participant in the learning process!

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/Assignments
1		Introduction Review of Laminar Fluid Flow	HWU, Ch. 1
2		Non-Newtonian Flow The Boundary Layer	HWU, Ch. 1
3		Multiphase Flow Introduction Two Phase Gas-Liquid Flow,	HWU, Ch. 2
4		Two Phase Liquid-Solid Flow, Two Phase Liquid-Liquid Flow	HWU, Ch. 2
5		Compressible Flow Introduction, Key Equations,	HWU, Ch. 3
6		Compressible Flow Through a Nozzle, Compressible Flow in a Pipe	HWU, Ch. 3
7		Continuity And Navier-Stokes Introduction, Continuity Equation, Momentum Balance	HWU, Ch. 4
8		**Mid-Term Exam**	
9		Navier-Stokes Equations, Velocity Potential and Stream Functions, Analytical Solution to the Navier Stokes Equation	HWU, Ch. 4
10		Flow Through Packed Beds and Porous Media Introduction, Flow in a Packed Bed	HWU, Ch. 5
11		Flow Through Porous Media Multi-Phase Flow – Single Dimension	HWU, Ch. 5
12		Modelling Introduction Recap on Visual Basic in Excel Numerical Integration	HWU, Ch. 6
13		Finding Roots ff Equations Introduction to Errors in Numerical Methods Sub Programs – What They Can Do Optimization Optimization of Multivariate Functions	HWU, Ch. 6
14		Numerical Solution Methods Introduction Finite Differences One Dimensional Steady State Heat Flow Equation Numerical Solutions of 2d Laplace's Equation	HWU, Ch. 7

16	TBA	**Final Exam**	

This syllabus is a guide for the course and any modifications to it will be announced in advance.